

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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Ex parte CHAO-KUN HU, ROBERT ROSENBERG, JUDITH MARIE RUBINO,  
CARLOS JUAN SAMBUCETTI, and ANTHONY KENDALL STAMPER

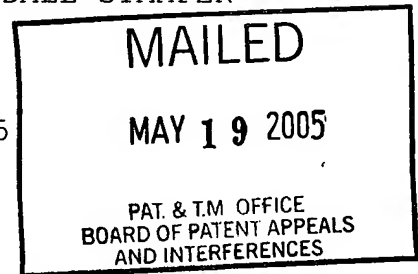
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Appeal No. 2005-0998  
Application No. 10/054,605

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ON BRIEF

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Before CAROFF, JEFFREY T. SMITH, and PAWLIKOWSKI, Administrative Patent Judges.

CAROFF, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the examiner's final rejection of claims 1-5, 7-10, 18-22, 24-27 and 35-38, all the claims now pending in appellants' involved application.

The appealed claims are directed to a method for forming conductors having high electromigration resistance by forming a conductive film of 1-20 nanometers thickness over the upper surface of a conductor element. We note that in the prior art

cited by the examiner such conductive films or coatings are referred to as a "barrier layer," a "diffusion barrier," or a "cap layer" in the field of semiconductor manufacturing. For instance, see Hong et al. (col. 1, ll. 13-16), and Zhao et al. (col. 8, ll. 7-11). The conductor element is typically composed of copper.

Claim 18, which is one of two independent claims, is illustrative of the subject matter at issue:

18. A method for forming conductors with high electromigration resistance comprising

forming a layer of dielectric on a substrate,

forming at least one trench in said layer of dielectric,

forming a metal liner in said trench,

forming a conductor on said metal liner filling said trench,

forming a planarized upper surface of said conductor planar with the upper surface of said layer of dielectric, and

forming a conductive film over said upper surface of said conductor, said conductive film forming a metal to metal metallurgical bond

and wherein said conductive film has a thickness of 1 to 20 nanometers.

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The prior art references relied upon by the examiner are:

Zhao et al. (Zhao)	5,674,787	Oct. 7, 1997
Dubin et al. (Dubin)	5,695,810	Dec. 9, 1997
Hong et al. (Hong)	6,077,774	Jun. 20, 2000
Lee et al. (Lee)	6,180,523	Jan. 30, 2001
Maydan et al. (Maydan)	6,372,633	Apr. 16, 2002

All of the appealed claims stand rejected for obviousness under 35 U.S.C. § 103(a). The examiner has chosen to present the case for obviousness in terms of five separate rejections. With respect to each rejection, the claims, and the references applied against those claims, are grouped as follows:

1. Claims 1-4 and 18-21 (Dubin in view of Hong).
2. Claims 1, 9-10, 18, and 26-27 (Maydan in view of Hong).
3. Claims 1-2 and 18-19 (Lee in view of Hong).
4. Claims 5, 7, 22 24, and 37-38 (Dubin in view of Hong and Zhao).
5. Claims 8, 25 and 35-36 (Lee in view of Hong and Zhao).

We have carefully considered the entire record in light of the opposing positions taken by the appellants and by the examiner. Having done so, we conclude that each combination of references relied upon by the examiner supports a prima facie case of obviousness with respect to the rejected claims. Accordingly, we shall affirm all of the rejections at issue for the following reasons:

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We will approach the two principal issues in this case much the same as appellants have done in their reply brief.

First, with regard to the combination of Hong with either Dubin, Maydan, or Lee (rejections 1, 2, and 3 above), we note that appellants stipulate on page 3 of their brief that, for each rejection, all of the involved claims stand or fall together. Thus, we need only consider claim 18.

With regard to claim 18, we agree with the examiner that it would have been prima facie obvious within the context of 35 U.S.C. § 103 to form an ultra-thin barrier layer, i.e., conductive film, over the surface of the conductor element, i.e., copper material, in any of the primary references to obtain the benefit of deep submicron low-resistance copper interconnects as suggested by Hong (col. 1, ll. 32-34).

Moreover, since instant claim 18 does not specify any particular conductive film material, it would have been especially obvious within the purview of 35 U.S.C. § 103 to substitute thin diffusion barriers composed of metal oxides or metal carbides, as taught by Hong, for those disclosed in Dubin, Maydan, or Lee since Hong suggests that such barrier layer

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materials prevent diffusion more effectively and can be used to form an ultra-thin diffusion barrier (col. 1, ll. 66-col. 2, l. 4; col. 5, ll. 19-23).

Second, with regard to the rejections involving Zhao (rejections 4 and 5 above), we again note appellants' stipulation that, for each rejection, all of the involved claims stand or fall together. Thus, we need only consider claim 5 (with regard to rejection 4) and claim 8 (with regard to rejection 5).

With regard to both claim 5 and claim 8, we agree with the examiner that it would have been prima facie obvious within the context of 35 U.S.C. § 103 to anneal the metal-phosphide barrier layer of Dubin or the metal-boron barrier layer of Lee, each having the thickness suggested by Hong, to obtain improved electrical properties as suggested by Zhao (col 3, ll. 30-5). Additionally, we agree with the examiner that it would have been prima facie obvious within the context of 35 U.S.C. § 103 to modify the specific annealing conditions disclosed by Zhao (col. 8, ll. 63-65) in order to optimize the resulting characteristics of any particular barrier layer/conductor construct. In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

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Appellants urge that the mere fact that annealing might be suitable for one type of material does not suggest it would be beneficial for a different material. We find this argument unpersuasive here since, in our opinion, Zhao appears to suggest that annealing would be beneficial for a variety of barrier layer materials. In this regard, we note that Zhao (col. 8, ll. 8-21) discloses that the barrier layer can be formed from "a variety of metals or metal alloys which have a barrier property to prevent copper diffusion." Further, Zhao places no limitation on the types of material for which annealing would be beneficial. Thus, it may be reasonably inferred from the Zhao disclosure that annealing is generally applicable and desirable. Appellants have not adduced any credible evidence to refute this inference. Accordingly, the inference stands unrebutted.

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For all of the foregoing reasons, the decision of the examiner is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED

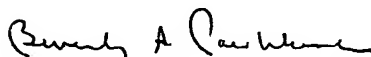


MARC L. CAROFF )  
Administrative Patent Judge )



JEFFREY T. SMITH )  
Administrative Patent Judge )

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APPEALS AND  
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BEVERLY A. PAWLIKOWSKI )  
Administrative Patent Judge )

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ROBERT M. TREPP  
IBM CORP.  
INTELLECTUAL PROPERTY LAW DEPT.  
P.O. BOX 218  
YORKTOWN HEIGHTS, NY 10598